UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/686,817	10/17/2003	Yoshifumi Arai	Q77855	8793

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

	Application No.	Applicant(s)
Office Action Summary	10/686,817	ARAI, YOSHIFUMI
	Examiner	Art Unit
	PETER L. CHENG	2625

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _10 January 2008_.

2a)☒ This action is **FINAL**.   2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-9,11,12 and 18_ is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-9,11,12 and 18_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _6/28/2004_ is/are: a)☐ accepted or b)☒ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All   b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Drawings

1.   The drawings are objected to because:

- **Fig. 12:** as with **page 68, line 26** [of the marked-up specification], it is

     suggested the word **Treble** be changed to **Triple**, or **Tripled**;

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to

the Office action to avoid abandonment of the application. Any amended replacement

drawing sheet should include all of the figures appearing on the immediate prior version

of the sheet, even if only one figure is being amended. The figure or figure number of an

amended drawing should not be labeled as "amended." If a drawing figure is to be

canceled, the appropriate figure must be removed from the replacement sheet, and

where necessary, the remaining figures must be renumbered and appropriate changes

made to the brief description of the several views of the drawings for consistency.

Additional replacement sheets may be necessary to show the renumbering of the

remaining figures. Each drawing sheet submitted after the filing date of an application

must be labeled in the top margin as either "Replacement Sheet" or "New Sheet"

pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the

applicant will be notified and informed of any required corrective action in the next Office

action. The objection to the drawings will not be held in abeyance.

Specification

1. The disclosure is objected to because of the following informalities:

    Please note that the following page/line numbers refer to the marked-up

    specification.

    - Recommend correcting the following typographical or grammatical errors in

      the disclosure; for example, **page 2 line 14; page 9, line 23; page 22, line 9;**

      page 25, line 1; page 50, line 26 (remove ":"); **page 9, line 20** (as with page

      9, line 20, replace "1," with "1",); **page 22, line 6** (as with page 22, line 10,

      replace "1," with "1",); **page 32, line 14** (replace "grasped" with "determined",

      or similar wording); **page 35, line 27** (replace "part of high" with "part of the

      high"); **page 39, lines 19- 20** (replace "to be" with "are"); **page 43, lines 19-**

      22 (remove ":" after "because" and rephrase); **page 57, line 5** (replace "is"

      with "are"); **page 64, line 23** (replace "grasps" with "determines", or similar

      wording); **page 77, line 10** (replace "acquired" with "acquires", or similar

      wording); **page 78, line 28** (replace "grasps" with "determines", or similar

      wording); **page 80, line 7** (replace "3." with "3".);

- **page 10, lines 21, 22, 24, 26; page 15, line 6; page 32, line 13:** as with the description on **page 8, lines 15-19,** since an unsigned 8-bit value has 256 integral values from 0 to 255, suggest replacing **256** with **255**;

- **page 15, lines 14 - 15:** please rewrite the sentence containing **cannot be indefinitely** *considered*; it is assumed that applicant intended to cite "**... a deviation equivalent to the fractional portion ... cannot be indefinitely** *ignored*", or similar wording;

- **page 20, line 19; page 41, line 12:** suggest **a print operation** instead of **print operation**;

- **page 32, line 22:** please rewrite the sentence containing **cannot be indefinitely** *considered*; it is assumed that applicant intended to cite "**... a deviation equivalent to the fractional portion ... cannot be indefinitely** *ignored*", or similar wording;

- **Page 51, lines 21 - 23:** for clarity, please rewrite the phrase, **a smaller value in CMYKlclm data after color separation does not necessarily** *more greatly vary* **between before and after [gamma] correction**;

- **Page 52, lines 16 - 17:** per **Fig. 6**, the "first gradation value data" [3rd table from the left] results from "color separation"; for clarity, please rewrite the sentence, **Accordingly, only** <u>**data after color separation**</u> *does not correspond* **to the first gradation value data**; this appears to contradict what is illustrated in **Fig. 6**; it is assumed that applicant intended to cite, **Accordingly, data other than "data after color separation" may correspond to the first gradation value data**, or similar wording;

- **Page 66, line 27:** as shown in **Fig. 6**, data obtained by carrying out color separation [i.e., 3rd table from the left] is then subjected to *gamma correction for resolution enhancement*; for clarity, it is assumed that applicant intended to cite **resolution enhancement** instead of **interpolation accuracy enhancement**;

- **Page 74, lines 23 - 25:** for clarity, please rewrite the phrase **a smaller value in CMYKlclm data after color separation does not necessarily** *<u>more greatly vary</u>* **between before and after [gamma] correction**;

- **Page 74, lines 25 - 28:** for clarity, please rewrite the phrase **a smaller value in CMYKlclm data will** *<u>more greatly vary</u>* **between before and after [gamma] correction**;

Appropriate correction is required.

Claim Objections

2. Claim 3 is objected to because of the following informalities:

- **Page 6, line 18:** as with claim 1, it is assumed that applicant intended to cite **"one step-variation"** (*or* "one step variation") instead of **"one-step variation"**;

3. Claim 7 is objected to because of the following informalities:

- **Page 10, line 5:** as with claim 1, it is assumed that applicant intended to cite **"one step-variation"** instead of **"one-step variation"**;

4. Claim 8 is objected to because of the following informalities:

- **Page 11, line 8:** as with claim 1, it is assumed that applicant intended to cite **"one step-variation"** instead of **"one-step variation"**;

- **Page 11, line 13:** **"the result of the print operation"** lacks antecedent basis; it is assumed that applicant intended to cite **"a result of the print operation"**;

- **Page 11, line 18:** with reference to **page 11, line 13**, it is assumed that **"a result of the print operation"** should instead cite **"the result of the print operation"**;

5. Claim 9 is objected to because of the following informalities:

- **Page 12, line 25:** as with claim 1, it is assumed that applicant intended to cite **"one step-variation"** instead of **"one-step variation"**;

- **Page 13, line 4:** **"the result of the print operation"** lacks antecedent basis; it is assumed that applicant intended to cite **"a result of the print operation"**;

- **Page 13, line 9:** with reference to **page 13, line 14**, it is assumed that **"a result of the print operation"** should instead cite **"the result of the print operation"**;

6. Claim 11 is objected to because of the following informalities:

- **Page 14, lines 3 - 4:** **"the total number of gradations"** lacks antecedent basis; as with claim 1, it is assumed that applicant intended to cite **"a total number of gradations"**;

- **Page 14, line 20:** as with claim 1, it is assumed that applicant intended to
  cite **"one step-variation"** instead of **"one-step variation"**;

7. Claim 12 is objected to because of the following informalities:

- **Page 15, line 10:** with reference to **page 14, lines 3 - 4**, and as with claim 2,
  it is assumed that **"a total number of gradations"** should instead cite **"the
  total number of gradations"**;

8. Claim 18 is objected to because of the following informalities:

- **Page 16, line 18:** as with claim 1, it is assumed that applicant intended to
  cite **"one step-variation"** instead of **"one-step variation"**;

Appropriate correction is required.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

10. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148

USPQ 459 (1966), that are applied for establishing a background for determining

obviousness under 35 U.S.C. 103(a) are summarized as follows:

1.   Determining the scope and contents of the prior art.
2.   Ascertaining the differences between the prior art and the claims at issue.
3.   Resolving the level of ordinary skill in the pertinent art.
4.   Considering objective evidence present in the application indicating obviousness or nonobviousness.

11. Claims 1 - 6, 8, 9, and 11 - 12 are rejected under 35 U.S.C. 103(a) as being

unpatentable over **JACOBS [US Patent 5,481,655]** in view of **MAHY [6,575,095**

B1].

As for claim 1, JACOBS teaches a color conversion table generating method wherein a

plurality of patches outputted from a printing device **[Fig. 2** color patches **32]** are

subjected to color measuring **[Fig. 2** spectrophotometer **36]** and a color conversion

table **[Fig. 6** custom ink table **74]** which defines ~~the~~ a correspondence between ~~the~~

color component values of various colors used in another image device **[Fig. 6** monitor

model **22]** and ink value data corresponding to ~~the~~ ink quantities of inks in individual ink

colors used in the printing device **[Fig. 6** master ink table **70]** is generated based on ~~the~~

a result of the color measuring, the method comprising:

~~a step for~~ extracting a ~~smaller~~ number of reference smaller values than ~~the~~

a total number of gradations in said ink value data with respect to each ink

color and combining ~~them~~ the reference values thereby to create patch

data which specifies ~~a~~ said plurality of ~~said~~ patches

["The printing device 12 receives a plurality of stepped ink values, such as CMY

values, thereby to produce a collection 30 of color patches 32"; **col. 5, lines 33 -**

36];

a step for performing halftone processing where the patch data is inputted input

and transformed into half tone image data which indicates the a presence or

absence of ink dots to print a said plurality of said patches;

and a step for generating said color conversion table based on color

measuring data obtained by subjecting a said plurality of the printed

patches to color measuring

["a spectrophotometer 36 … is utilized to measure the color value, in the selected

colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 -**

51],

wherein the colors in said patch data are colors obtained by extracting a

smaller number of reference values *before correction* smaller than the total

number of gradations in predetermined gradation values *before correction*,

from the gradation values *before correction*, with respect to each ink color

and combining the reference values *before correction*

["The printing device 12 receives a plurality of stepped ink values, such as CMY

values, thereby to produce a collection 30 of color patches 32. As is known in

the art, the ink values typically have the intensity values of grid points 33 (FIG.

3A) on a three-dimensional grid 34 and there is one ink value for each grid point

33"; **col. 5, lines 33 - 39],**

carrying out *correction for interpolation accuracy enhancement* *to increase the*

reference values before correction, and thereby bringing the magnitude of values

after the correction and the ink quantity into substantially linear correspondence

with each other;

wherein said *ink value data* *is defined so that a gradation value which is an*

integral value existing in a predetermined range of value and corresponds to a

higher-lightness range will be reduced in ~~the~~ *an ink recording rate corresponding*

to ~~the~~ *a unit variation in that gradation value as compared with gradation values*

corresponding to a lower-lightness range;

and wherein *in said half tone processing, gradations are represented by*

adjusting a count of dots recorded per unit area and one step-variation in

gradation results in a large number of steps in dot variation, thus subtle variation

which is substantially equivalent to a fractional portion is represented,

and ~~in said halftone processing,~~ *ink quantities corresponding to the reference*

values in said patch data are *interpreted* *according to* ~~the~~ *a definition of the*

gradation values, while keeping the subtle variation which is substantially

equivalent to the fractional portion, *to generate said halftone image data.*

However, JACOBS does not teach

a step for performing halftone processing where the patch data is inputted

input and transformed into half tone image data which indicates the a

presence or absence of ink dots to print a said plurality of said patches;

carrying out correction for interpolation accuracy enhancement to increase

the reference values before correction, and thereby bringing the magnitude

of values after the correction and the ink quantity into substantially linear

correspondence with each other;

wherein said ink value data is defined so that a gradation value which is an

integral value existing in a predetermined range of value and corresponds

to a higher-lightness range will be reduced in the an ink recording rate

corresponding to the a unit variation in that gradation value as compared

with gradation values corresponding to a lower-lightness range;

and wherein in said half tone processing, gradations are represented by

adjusting a count of dots recorded per unit area and one step-variation in

gradation results in a large number of steps in dot variation, thus subtle

<u>variation which is substantially equivalent to a fractional portion is</u>

<u>represented,</u>

<u>and</u> ~~in said halftone processing,~~ ink quantities corresponding to the

reference values in said patch data are <u>interpreted</u> according to ~~the~~ <u>a</u>

definition of the gradation values<u>, while keeping the subtle variation which</u>

<u>is substantially equivalent to the fractional portion,</u> to generate said

halftone image data.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4**

and 5 illustrate the conversion of color data from one color space (e.g., L*a*b* on the

left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened")

CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone

data for cyan which consists of both light and dark marking particles).   In this

conversion process, MAHY illustrates

> ~~a step for~~ **performing halftone processing where the patch data is ~~inputted~~**
>
> **<u>input</u> and transformed into half tone image data which indicates ~~the~~ <u>a</u>**
>
> **presence or absence of ink dots to print ~~a~~ <u>said</u> plurality of ~~said~~ patches**
>
> **[Fig. 5** "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63,**
>
> **64;**

From **Fig. 5,** MAHY teaches that the tone values t^*_{c1} and t^*_{c2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{c1} and t^{**}_{c2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**];**

carrying out <u>correction for interpolation accuracy enhancement</u> to increase the reference values before correction, and thereby bringing the magnitude of values after the correction and the ink quantity into substantially linear correspondence with each other

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively; **TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**];**

wherein said <u>ink value data</u> is defined so that a gradation value which is an integral value existing in a predetermined range of value and corresponds to a higher-lightness range will be reduced in ~~the~~ <u>an</u> ink recording rate

corresponding to ~~the~~ a unit variation in that gradation value as compared with gradation values corresponding to a lower-lightness range

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

and wherein <u>in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area</u>

[MAHY teaches that "*the invention may be applied to ink-jet printing.* The printing device is then an ink-jet printing device and the marking particles are liquid ink drops. The invention is especially suitable for ink-jet printing, because

in ink-jet printing it is common to use a plurality of different types of inks of the

same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 –**

36.

It is well-known in the art that ink-jet printers can halftone image data by

modulating the number of dots placed in a unit area of the receiving medium.

This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,**

where applicant cites, "Rather, an ink-jet printer can change the number of dots

applied to a medium per unit area to represent gradation value"**]**

and one step-variation in gradation results in a large number of steps in dot

variation, thus subtle variation which is substantially equivalent to a

fractional portion is represented

[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From

this table, MAHY illustrates a mapping between a colorant value, c_K to a tone

value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a

corresponding, larger variation in tone value (t_K) than at higher colorant values

(c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone

value t_K varies from 0% to 12%; a difference of <u>12%</u>. When c_K is in the range of

20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a

difference of 5%.

Therefore, it would have been obvious to one of ordinary skill in the art at the

time the invention was made to place more dots on the receiving medium for a

one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is

important because printing devices can only render a limited number of different

shades of a specific colour… This number is limited because of many involved

and often interrelated factors, such as the image resolution and the screening

technique that are used, *the number of bits that are used to represent a colour in*

different stages of the process, the number of levels of the halftoning process,

…"; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to*

represent color allows for finer variations to be expressed which correspond to a

computationally higher resolution "fractional portion"]**.**

and ~~in said halftone processing,~~ ink quantities corresponding to the

reference values in said patch data are interpreted according to ~~the~~ a

definition of the gradation values, while keeping the subtle variation which

is substantially equivalent to the fractional portion, to generate said

halftone image data

[From **Fig. 5,** MAHY teaches that the tone values t^*_{c1} and t^*_{c2} are interpreted by

"screening LUT's" **66, 67, 68, 69** to produce t^{**}_{c1} and t^{**}_{c2}, respectively which, in

turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone

image data].

It would have been obvious to one of ordinary skill in the art at the time the invention

was made to combine the teachings of JACOBS with those of MAHY to enable one to

generate a color conversion table so that colors output on one device would match

those of a given printing device. JACOBS teaches the concept of matching colors

between output devices while MAHY teaches the concepts of linearizing color output

response, color separation and halftoning when performing a print operation.

As for claim 2, MAHY further teaches the color conversion table generating method

according to Claim 1, wherein

said ink value data is defined by allocating the total number of gradations

to part of the range of ~~value~~ **values of said ink recording rate**

[With respect to Fig. 8, MAHY teaches a case when "there are almost no colour

differences between the patches of a wedge in a specific tone value interval,

usually an interval from a specific tone value A% to 100%"; **col. 24, lines 27 –**

30. In this case, MAHY teaches that the tone values above A% can be ignored

(or "clipped"). "The advantage of the clipping operation is that the average

spacing between the t-levels in the interval from 0% to A% may be smaller, which

results in more accurate colour representation"; **col. 24, lines 44 - 47].**

As for claim 3, JACOBS teaches a color conversion table generating method for

generating a color conversion table which defines ~~the~~ a correspondence between ink

value data which specifies ~~the~~ ink quantities of inks in individual colors used in a printing

device **[Fig. 6** master ink table **70]** and ~~the~~ color component values of various colors

used in another image device **[Fig. 6** monitor model **22]**, the method comprising:

> *~~a step for~~ extracting gradation values where ~~the~~ an ink quantity and ~~the~~ a*
>
> *magnitude of ~~the~~ gradation values are in substantially linear correspondence*
>
> *with each other with respect to each ink color and combining ~~them~~ the gradation*
>
> *values to create first gradation value data;*

> *~~a step for~~ subjecting the first gradation value data to correction for resolution*
>
> *enhancement with a higher rate of increase applied to a gradation value*
>
> *corresponding to a high-lightness range than to gradation values corresponding*
>
> *to a ~~lower~~ low-lightness range, to obtain said ink value data;*

> *~~a step for~~ performing halftone processing, wherein gradations are represented by*
>
> *adjusting a count of dots recorded per unit area, and one step-variation in*
>
> *gradation results in a large number of steps in dot variation, thus subtle variation*

which is substantially equivalent to a fractional portion is represented, and in said

half tone processing, taking into account deviations equivalent to fractional

portions obtained when the ink value data is subjected to correction inverse to

said correction for resolution enhancement to perform a print operation;

and a step for generating a color conversion table where said ink value

data and the color component values of various colors used in said

another image device are in correspondence with each other based on

color measuring data [using a spectrophotometer **36** as shown in **Fig. 2**]

obtained by subjecting the result of the print operation to color measuring

[**Fig. 6** custom table builder **72** produces a "custom ink table" **74** by bringing

colors indicated by combinations of input gradation values (i.e., the "master ink

table" **70** of the printer) and colors indicated by combinations of said color

component values (i.e., the monitor model **22**) into correspondence with each

other];

wherein, said first gradation value data is extracted beforehand so that colors in

the low-lightness range will be larger in number than colors in the high-lightness

range so as to compensate the resolution which is relatively degraded in the low-

lightness range by said correction for resolution enhancement by interpolation

accuracy.

However, JACOBS does not teach

a step for extracting gradation values where the an ink quantity and the a

magnitude of the gradation values are in substantially linear

correspondence with each other with respect to each ink color and

combining them the gradation values to create first gradation value data;

a step for subjecting the first gradation value data to correction for

resolution enhancement with a higher rate of increase applied to a

gradation value corresponding to a high-lightness range than to gradation

values corresponding to a lower low-lightness range, to obtain said ink

value data;

a step for performing halftone processing, **wherein gradations are**

represented by adjusting a count of dots recorded per unit area, and one

step-variation in gradation results in a large number of steps in dot

variation, thus subtle variation which is substantially equivalent to a

fractional portion is represented,

and in said half tone processing, taking into account deviations equivalent

to fractional portions obtained when the ink value data is subjected to

correction inverse to said correction for resolution enhancement to

perform a print operation;

wherein, said first gradation value data is extracted beforehand so that

colors in the low-lightness range will be larger in number than colors in the

high-lightness range so as to compensate the resolution which is relatively

degraded in the low-lightness range by said correction for resolution

enhancement by interpolation accuracy.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4**

and 5 illustrate the conversion of color data from one color space (e.g., L*a*b* on the

left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened")

CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone

data for cyan which consists of both light and dark marking particles).   In this

conversion process, MAHY illustrates

> ~~a step for~~ **extracting gradation values where** ~~the~~ **an ink quantity and** ~~the~~ **a**
>
> **magnitude of** ~~the~~ **gradation values are in substantially linear**
>
> **correspondence with each other with respect to each ink color and**
>
> **combining** ~~them~~ **the gradation values to create first gradation value data**
>
> **[Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow,
>
> and black, respectively; **TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for
>
> black) and the relation between colorant value, c_K and tone value t_K; the
>
> corresponding lookup table (LUT) attempts to linearize the response (i.e., the

"lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)];

~~a step for~~ **subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range, to obtain said ink value data**

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness

range). **Fig. 5** further illustrates that both light and dark tone values are further

calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are

complemented by the "screening LUT's" **66, 67, 68, 69];**

~~a step for~~ **performing halftone processing, <u>wherein gradations are</u>**

<u>represented by adjusting a count of dots recorded per unit area</u>

[MAHY teaches that "*the invention may be applied to ink-jet printing.* The

printing device is then an ink-jet printing device and the marking particles are

liquid ink drops. The invention is especially suitable for ink-jet printing, because

in ink-jet printing it is common to use a plurality of different types of inks of the

same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 –**

36.

It is well-known in the art that ink-jet printers can halftone image data by

modulating the number of dots placed in a unit area of the receiving medium.

This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,**

where applicant cites, "Rather, an ink-jet printer can change the number of dots

applied to a medium per unit area to represent gradation value"**],**

<u>and one step-variation in gradation results in a large number of steps in dot</u>

<u>variation, thus subtle variation which is substantially equivalent to a</u>

<u>fractional portion is represented</u>

[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From

this table, MAHY illustrates a mapping between a colorant value, c_K to a tone

value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a

corresponding, larger variation in tone value (t_K) than at higher colorant values

(c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone

value t_K varies from 0% to 12%; a difference of <u>12%</u>. When c_K is in the range of

20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a

difference of <u>5%</u>.

Therefore, it would have been obvious to one of ordinary skill in the art at the

time the invention was made to place more dots on the receiving medium for a

one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is

important because printing devices can only render a limited number of different

shades of a specific colour... This number is limited because of many involved

and often interrelated factors, such as the image resolution and the screening

technique that are used, *the number of bits that are used to represent a colour in*

different stages of the process, the number of levels of the halftoning process,

..."; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution "fractional portion"],

and in said half tone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform a print operation

[From **Fig. 5,** MAHY teaches that the tone values t^*_{c1} and t^*_{c2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{c1} and t^{**}_{c2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data];

wherein, said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy

[**Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively; **TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the

corresponding lookup table (LUT) attempts to linearize the response (i.e., the

"lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K

which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g.,

c_K) to tone values (e.g., t_K)].

It would have been obvious to one of ordinary skill in the art at the time the invention

was made to combine the teachings of JACOBS with those of MAHY to enable one to

generate a color conversion table so that colors output on one device would match

those of a given printing device. JACOBS teaches the concept of matching colors

between output devices while MAHY teaches the concepts of linearizing color output

response, color separation and halftoning when performing a print operation.

As for claim 4, MAHY further teaches the color conversion table generating method

according to Claim 3, wherein

> **the gradation values in said <u>first gradation value data</u> are created based on**
>
> **data obtained by transforming coordinates in a predetermined color space**
>
> **constituted of a smaller number of color components than ~~the~~ <u>a </u>number of**
>
> **ink colors into gradation values which indicate the quantities of individual**
>
> **color inks by a predetermined transformation expression**

[For a printer with both light and dark marking particles, MAHY teaches a step

where a colorant tone value is separated into separate tone values for both light

and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31**

and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that

transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and

into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine

respectively an amount of light cyan marking particles and an amount of dark

cyan marking particles that are to be applied to a receiving substrate"; **col. 22,**

lines 2 – 8. The "predetermined transformation expression" corresponds to the

"mixing table"].

As for claim 5, MAHY further teaches the color conversion table generating method

according to Claim 3, wherein

> **the gradation values in said <u>first gradation value data</u> are obtained by**
>
> **subjecting gradation values where the ink quantity and the magnitude of**
>
> **gradation values are in substantially linear correspondence with each other**
>
> **to [gamma] correction where a smaller gradation value is corrected with**
>
> **a higher rate of increase as compared with larger gradation values and ~~the~~**
>
> **<u>a</u> result of the correction is outputted**
>
> [**Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow,
>
> and black, respectively; **TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for
>
> black) and the relation between colorant value, c_K and tone value t_K; the

corresponding lookup table (LUT) attempts to linearize the response (i.e., the

"lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K

which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g.,

c_K) to tone values (e.g., t_K)].

MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). In this

example, MAHY illustrates that smaller gradation values are corrected with a

higher rate of increase as compared to larger gradation values; for example,

when c_K (in table column 3) is 10%, the output of the LUT (in table column 5) is

20%; this corresponds to a doubling (or increase of 100%) in tone value;

however, when the colorant value c_K is 80%, the output of the LUT is %74; this

difference corresponds to just a 7.5% change].

As for claim 6, MAHY further teaches the color conversion table generating method

according to Claim 3, wherein

> **a gradation value which indicates the lowest lightness in said <u>first</u>**
>
> **<u>gradation value data</u> is equivalent to ~~the~~ a highest ink recording rate at**
>
> **which the ink can be recorded on a printing medium**
>
> [This gradation value corresponds to point **A%** in **Fig. 8**];

and in said <u>correction for resolution enhancement</u>, a predetermined

gradation value range containing the gradation value which indicates the

lowest lightness is excluded and the correction is carried out so that the

remaining gradation value range will be matched with the whole gradation

value range of said ink value data

[With respect to **Fig. 8**, MAHY teaches a case when "there are almost no colour

differences between the patches of a wedge in a specific tone value interval,

usually an interval from a specific tone value A% to 100%"; **col. 24, lines 27 –**

30. In this case, MAHY teaches that the tone values above A% can be ignored

(or "clipped"). "The advantage of the clipping operation is that the average

spacing between the t-levels in the interval from 0% to A% may be smaller, which

results in more accurate colour representation"; **col. 24, lines 44 - 47].**

As for claim 8, JACOBS teaches a color conversion table generator which generates a

color conversion table which defines ~~the~~ <u>a</u> correspondence between ink value data

which specifies ~~the~~ ink quantities of inks in individual colors used in a printing device

[Fig. 6 master ink table **70]** and ~~the~~ color component values of various colors used in

another image device **[Fig. 6** monitor model **22]**, the generator ~~comprise~~ <u>comprising</u>:

    a first gradation value data acquiring unit ~~for acquiring~~ <u>that acquires</u> first

    gradation value data obtained by extracting gradation values where ~~the~~ <u>an</u> ink

    quantity and ~~the~~ <u>a</u> magnitude of gradation values are in substantially linear

correspondence with each other with respect to each ink color and combining the

gradation values;

an ink value data acquiring unit ~~for subjecting~~ that subjects the first gradation

value data to correction for resolution enhancement with a higher rate of increase

applied to a gradation value corresponding to a ~~higher~~ high-lightness range than

to gradation values corresponding to a ~~lower~~ low-lightness range, to acquire ~~the~~

a result of the correction as said ink value data;

a print operation performing unit ~~for performing~~ that performs halftone

processing, wherein in said half tone processing, gradations are represented by

adjusting a count of dots recorded per unit area and one step-variation in

gradation results in a large number of steps in dot variation, thus subtle variation

which is substantially equivalent to a fractional portion is represented, said print

operation performing unit taking into account deviations equivalent to fractional

portions obtained when the ink value data is subjected to correction inverse to

said correction for resolution enhancement to perform a print operation;

a print result color measuring unit ~~**for subjecting**~~ **that subjects** ~~**the**~~ **a result**

of the print operation to color measuring

["a spectrophotometer 36 ... is utilized to measure the color value, in the selected

colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 -**

51];

and a color conversion table generating unit ~~for generating~~ <u>that generates</u>

a color conversion table where said ink value data and the color

component values of various colors used in said another image device are

in **correspondence with each other based on color measuring data**

obtained by subjecting *the* **result of the print operation to color measuring**

[Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing

colors indicated by combinations of input gradation values (i.e., the "master ink

table" **70** of the printer) and colors indicated by combinations of said color

component values (i.e., the monitor model **22**) into correspondence with each

other]**,**

wherein said first gradation value data is extracted beforehand so that colors in

the low-lightness range will be larger in number than colors in the high-lightness

range so as to compensate the resolution which is relatively degraded in the low-

lightness range by said correction for resolution enhancement by interpolation

accuracy.

However, JACOBS does not teach

a first gradation value data acquiring unit ~~for acquiring~~ that acquires first

gradation value data obtained by extracting gradation values where ~~the~~ an

ink quantity and ~~the~~ a magnitude of gradation values are in substantially

linear correspondence with each other with respect to each ink color and

combining the gradation values;

an ink value data acquiring unit ~~for subjecting~~ that subjects the first

gradation value data to correction for resolution enhancement with a

higher rate of increase applied to a gradation value corresponding to a

~~higher~~ high-lightness range than to gradation values corresponding to a

~~lower~~ low-lightness range, to acquire ~~the~~ a result of the correction as said

ink value data;

a print operation performing unit ~~for performing~~ that performs halftone

processing, wherein in said half tone processing, gradations are

represented by adjusting a count of dots recorded per unit area and one

step-variation in gradation results in a large number of steps in dot

variation, thus subtle variation which is substantially equivalent to a

fractional portion is represented, said print operation performing unit

taking into account deviations equivalent to fractional portions obtained

when the ink value data is subjected to correction inverse to said

correction for resolution enhancement to perform a print operation;

wherein said first gradation value data is extracted beforehand so that

colors in the low-lightness range will be larger in number than colors in the

high-lightness range so as to compensate the resolution which is relatively

degraded in the low-lightness range by said correction for resolution

enhancement by interpolation accuracy.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4**

and 5 illustrate the conversion of color data from one color space (e.g., L*a*b* on the

left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened")

CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone

data for cyan which consists of both light and dark marking particles).   In this

conversion process, MAHY illustrates

a first gradation value data acquiring unit ~~for acquiring~~ **that acquires first**

gradation value data obtained by extracting gradation values where ~~the~~ **an**

ink quantity and ~~the~~ **a magnitude of gradation values are in substantially**

linear correspondence with each other with respect to each ink color and

combining the gradation values

[**Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow,

and black, respectively; **TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for

black) and the relation between colorant value, c_K and tone value t_K; the

corresponding lookup table (LUT) attempts to linearize the response (i.e., the

"lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**]**;

an ink value data acquiring unit ~~for subjecting~~ <u>that subjects</u> the <u>first gradation value data</u> to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a ~~higher~~ <u>high</u>-lightness range than to gradation values corresponding to a ~~lower~~ <u>low</u>-lightness range<u>,</u> to acquire ~~the~~ <u>a</u> result of the correction as said ink value data

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-

lightness range) than at higher input tone values (i.e., in the lower-lightness

range). **Fig. 5** further illustrates that both light and dark tone values are further

calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are

complemented by the "screening LUT's" **66, 67, 68, 69]**;

a print operation performing unit ~~for performing~~ **that performs halftone**

processing, wherein in said half tone processing, gradations are

represented by adjusting a count of dots recorded per unit area

[MAHY teaches that "*the invention may be applied to ink-jet printing. The*

printing device is then an ink-jet printing device and the marking particles are

liquid ink drops. The invention is especially suitable for ink-jet printing, because

in ink-jet printing it is common to use a plurality of different types of inks of the

same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 –**

36.

It is well-known in the art that ink-jet printers can halftone image data by

modulating the number of dots placed in a unit area of the receiving medium.

This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,**

where applicant cites, "Rather, an ink-jet printer can change the number of dots

applied to a medium per unit area to represent gradation value"]

and one step-variation in gradation results in a large number of steps in dot

variation, thus subtle variation which is substantially equivalent to a

fractional portion is represented

[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From

this table, MAHY illustrates a mapping between a colorant value, c_K to a tone

value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a

corresponding, larger variation in tone value (t_K) than at higher colorant values

(c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone

value t_K varies from 0% to 12%; a difference of 12%. When c_K is in the range of

20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a

difference of 5%.

Therefore, it would have been obvious to one of ordinary skill in the art at the

time the invention was made to place more dots on the receiving medium for a

one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is

important because printing devices can only render a limited number of different

shades of a specific colour… This number is limited because of many involved

and often interrelated factors, such as the image resolution and the screening

technique that are used, *the number of bits that are used to represent a colour in different stages of the process*, the number of levels of the halftoning process, ...”; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution “fractional portion”],

said print operation performing unit taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform a print operation

[From **Fig. 5,** MAHY teaches that the tone values t^*_{c1} and t^*_{c2} are interpreted by “screening LUT’s” **66, 67, 68, 69** to produce t^{**}_{c1} and t^{**}_{c2}, respectively which, in turn, are processed by “screening algorithms” **61, 62, 63, 64** to produce halftone image data];

wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy

[**Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow,

and black, respectively; **TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for

black) and the relation between colorant value, c_K and tone value t_K; the

corresponding lookup table (LUT) attempts to linearize the response (i.e., the

"lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K

which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g.,

c_K) to tone values (e.g., t_K)].

It would have been obvious to one of ordinary skill in the art at the time the invention

was made to combine the teachings of JACOBS with those of MAHY to enable one to

generate a color conversion table so that colors output on one device would match

those of a given printing device. JACOBS teaches the concept of matching colors

between output devices while MAHY teaches the concepts of linearizing color output

response, color separation and halftoning when performing a print operation.

As for claim 9, JACOBS teaches a computer-readable medium with a color conversion

table generating program recorded thereon for to have a computer carry out a method

for generating a color conversion table which defines the a correspondence between ink

value data which specifies the ink quantities of inks in individual colors used in a printing

device [**Fig. 6** master ink table **70**] and the color component values of various colors

used in another image device **[Fig. 6** monitor model **22]**, ~~wherein the program causes a~~

~~computer to carry out~~ the method comprising:

> ~~a first gradation value data acquiring function of~~ acquiring first gradation value
>
> data obtained by extracting gradation values where ~~the~~ an ink quantity and ~~the~~ a
>
> magnitude of the gradation values are in substantially linear correspondence with
>
> each other with respect to each ink color and combining the gradation values;
>
> ~~an ink value data acquiring function of~~ subjecting the first gradation value data to
>
> correction for resolution enhancement with a higher rate of increase applied to a
>
> gradation value corresponding to a ~~higher~~ high-lightness range than to gradation
>
> values corresponding to a ~~lower~~ low-lightness range and acquiring ~~the~~ a result of
>
> the correction as said ink value data;
>
> ~~a print operation performing function of~~ performing half tone processing, wherein
>
> in said half tone processing, gradations are represented by adjusting a count of
>
> dots recorded per unit area and one step-variation in gradation results in a large
>
> number of steps in dot variation, thus subtle variation which is substantially
>
> equivalent to a fractional portion is represented, said half tone processing taking
>
> into account deviations equivalent to fractional portions obtained when the ink
>
> value data is subjected to correction inverse to said correction for resolution
>
> enhancement, and performing a print operation;

~~a print result color measuring function of~~ subjecting ~~the~~ a result of the print

operation to color measuring

["a spectrophotometer 36 … is utilized to measure the color value, in the selected

colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 -**

51];

and ~~a color conversion table generating function of~~ generating a color

conversion table where said ink value data and the color component values

of various colors used in said another image device are in correspondence

with each other based on color measuring data obtained by subjecting ~~the~~

a result of the print operation to color measuring

[**Fig. 6** custom table builder **72** produces a "custom ink table" **74** by bringing

colors indicated by combinations of input gradation values (i.e., the "master ink

table" **70** of the printer) and colors indicated by combinations of said color

component values (i.e., the monitor model **22**) into correspondence with each

other];

wherein said first gradation value data is extracted beforehand so that colors in

the low-lightness range will be larger in number than colors in the high-lightness

range so as to compensate the resolution which is relatively degraded in the low-

lightness range by said correction for resolution enhancement by interpolation

accuracy.

However, JACOBS does not teach

a first gradation value data acquiring function of acquiring first gradation

value data obtained by extracting gradation values where the an ink

quantity and the a magnitude of the gradation values are in substantially

linear correspondence with each other with respect to each ink color and

combining the gradation values;

an ink value data acquiring function of subjecting the first gradation value

data to correction for resolution enhancement with a higher rate of

increase applied to a gradation value corresponding to a higher high-

lightness range than to gradation values corresponding to a lower low-

lightness range and acquiring the a result of the correction as said ink

value data;

a print operation performing function of performing half tone processing,

wherein in said half tone processing, gradations are represented by

adjusting a count of dots recorded per unit area and one step-variation in

gradation results in a large number of steps in dot variation, thus subtle

variation which is substantially equivalent to a fractional portion is

represented, said half tone processing taking into account deviations

equivalent to fractional portions obtained when the ink value data is

subjected to correction inverse to said correction for resolution

enhancement, and performing a print operation;

wherein said first gradation value data is extracted beforehand so that

colors in the low-lightness range will be larger in number than colors in the

high-lightness range so as to compensate the resolution which is relatively

degraded in the low-lightness range by said correction for resolution

enhancement by interpolation accuracy.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4**

and 5 illustrate the conversion of color data from one color space (e.g., L*a*b* on the

left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened")

CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone

data for cyan which consists of both light and dark marking particles).   In this

conversion process, MAHY illustrates

> ~~a first gradation value data acquiring function of~~ **acquiring first gradation**
>
> **value data obtained by extracting gradation values where** ~~the~~ **an ink**
>
> **quantity and** ~~the~~ **a magnitude of the gradation values are in substantially**
>
> **linear correspondence with each other with respect to each ink color and**
>
> **combining the gradation values**
>
> [**Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow,
>
> and black, respectively; **TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for

black) and the relation between colorant value, c_K and tone value t_K; the

corresponding lookup table (LUT) attempts to linearize the response (i.e., the

"lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K

which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g.,

c_K) to tone values (e.g., t_K)];

an ink value data acquiring function of **subjecting the first gradation value**

data to correction for resolution enhancement with a higher rate of

increase applied to a gradation value corresponding to a ~~higher~~ high-

lightness range than to gradation values corresponding to a ~~lower~~ low-

lightness range and acquiring ~~the~~ a result of the correction as said ink

value data

[For a printer with both light and dark marking particles, MAHY teaches a step

where a colorant tone value is separated into separate tone values for both light

and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31**

and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that

transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and

into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine

respectively an amount of light cyan marking particles and an amount of dark

cyan marking particles that are to be applied to a receiving substrate"; **col. 22,**

lines 2 – 8. With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69]**;

~~a print operation performing function of~~ **performing half tone processing, wherein in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area**

[MAHY teaches that "*the invention may be applied to ink-jet printing. The printing device is then an ink-jet printing device and the marking particles are liquid ink drops. The invention is especially suitable for ink-jet printing, because in ink-jet printing it is common to use a plurality of different types of inks of the same colorant hue, such as light cyan ink and dark cyan ink*"; **col. 25, lines 30 – 36.**

It is well-known in the art that ink-jet printers can halftone image data by modulating the number of dots placed in a unit area of the receiving medium. This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,** where applicant cites, "Rather, an ink-jet printer can change the number of dots applied to a medium per unit area to represent gradation value"]

and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented

[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From this table, MAHY illustrates a mapping between a colorant value, c_K to a tone value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a corresponding, larger variation in tone value (t_K) than at higher colorant values (c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone value t_K varies from 0% to 12%; a difference of 12%. When c_K is in the range of 20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a difference of 5%.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to place more dots on the receiving medium for a one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is important because printing devices can only render a limited number of different shades of a specific colour... This number is limited because of many involved

and often interrelated factors, such as the image resolution and the screening

technique that are used, *the number of bits that are used to represent a colour in*

different stages of the process, the number of levels of the halftoning process,

...”; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to*

represent color allows for finer variations to be expressed which correspond to a

computationally higher resolution “fractional portion”],

said half tone processing taking into account deviations equivalent to

fractional portions obtained when the ink value data is subjected to

correction inverse to said correction for resolution enhancement, and

performing a print operation

[From **Fig. 5,** MAHY teaches that the tone values t^*_{c1} and t^*_{c2} are interpreted by

“screening LUT’s” **66, 67, 68, 69** to produce t^{**}_{c1} and t^{**}_{c2}, respectively which, in

turn, are processed by “screening algorithms” **61, 62, 63, 64** to produce halftone

image data];

wherein said first gradation value data is extracted beforehand so that

colors in the low-lightness range will be larger in number than colors in the

high-lightness range so as to compensate the resolution which is relatively

degraded in the low-lightness range by said correction for resolution

enhancement by interpolation accuracy

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow,

and black, respectively; TABLE 1 in cols. 16 and 17 illustrates curve 48 (for

black) and the relation between colorant value, c_K and tone value t_K; the

corresponding lookup table (LUT) attempts to linearize the response (i.e., the

"lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K

which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g.,

c_K) to tone values (e.g., t_K)].

It would have been obvious to one of ordinary skill in the art at the time the invention

was made to combine the teachings of JACOBS with those of MAHY to enable one to

generate a color conversion table so that colors output on one device would match

those of a given printing device. JACOBS teaches the concept of matching colors

between output devices while MAHY teaches the concepts of linearizing color output

response, color separation and halftoning when performing a print operation.

As for claim 11, JACOBS teaches a <u>correspondence definition data</u> [i.e., a color

conversion table] creating method wherein plurality of patches outputted from a printing

device [Fig. 2 color patches 32] are subjected to color measuring [Fig. 2

spectrophotometer **36]**, and correspondence definition data **[Fig. 6** custom ink table **74]**

which defines ~~the~~ a correspondence between ~~the~~ color component values of various

colors used in another image device **[Fig. 6** monitor model **22]** and gradation values

corresponding to ~~the~~ ink quantities of inks in individual colors used in the printing device

[Fig. 6 master ink table **70]** is created based on ~~the~~ a result of the color measuring, the

method comprising:

> **~~a step for~~ extracting a ~~smaller~~ number of reference values smaller than ~~the~~**
>
> **a total number of gradations in gradation values corresponding to said ink**
>
> **quantities with ~~respected~~ respect to each ink color and combining ~~them~~ the**
>
> **reference values thereby to create patch data which specifies ~~a~~ said**
>
> **plurality of ~~said~~ patches**
>
> ["The printing device 12 receives a plurality of stepped ink values, such as CMY
>
> values, thereby to produce a collection 30 of color patches 32"; **col. 5, lines 33 -**
>
> **36];**

> *~~a step for~~ performing halftone processing where the patch data is ~~inputted~~ input*
>
> *and transformed into halftone image data which indicates ~~the~~ a presence or*
>
> *absence of ink dots to print ~~a~~ said plurality of ~~said~~ patches;*

> **and ~~a step for~~ creating said correspondence definition data based on color**
>
> **measuring data obtained by subjecting ~~a~~ said plurality of ~~the~~ printed**
>
> **patches to color measuring**

["a spectrophotometer 36 … is utilized to measure the color value, in the selected

colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 -**

51],

wherein gradation values corresponding to said ink quantities are so defined that

a gradation value which is an integral value existing in a predetermined range of

value ~~value~~ values and corresponds to a ~~higher~~ high-lightness range will be reduced in

~~the~~ an ink recording rate corresponding to ~~the~~ a unit variation in that gradation

value as compared with gradation values corresponding to a ~~lower~~ low-lightness

range;

and wherein in said halftone processing, gradations are represented by adjusting

a count of dots recorded per unit area, and one step-variation in gradation results

in a large number of steps in dot variation, thus subtle variation which is

substantially equivalent to a fractional portion is represented, and ink quantities

corresponding to reference values in said patch data are interpreted according to

~~the~~ a definition of the gradation values, while keeping the subtle variation which

is substantially equivalent to the fractional portion, to generate said half tone

image data.

However, JACOBS does not teach

a step for performing halftone processing where the patch data is inputted

input and transformed into halftone image data which indicates the a

presence or absence of ink dots to print a said plurality of said patches;

wherein gradation values corresponding to said ink quantities are so

defined that a gradation value which is an integral value existing in a

predetermined range of value values and corresponds to a higher high-

lightness range will be reduced in the an ink recording rate corresponding

to the a unit variation in that gradation value as compared with gradation

values corresponding to a lower low-lightness range;

and wherein in said halftone processing, gradations are represented by

adjusting a count of dots recorded per unit area, and one step-variation in

gradation results in a large number of steps in dot variation, thus subtle

variation which is substantially equivalent to a fractional portion is

represented, and ink quantities corresponding to reference values in said

patch data are interpreted according to the a definition of the gradation

values, while keeping the subtle variation which is substantially equivalent

to the fractional portion, to generate said half tone image data.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4**

and 5 illustrate the conversion of color data from one color space (e.g., L*a*b* on the

left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened")

CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone

data for cyan which consists of both light and dark marking particles).   In this

conversion process, MAHY illustrates

> ~~a step for~~ performing halftone processing where the patch data is ~~inputted~~
>
> input and transformed into halftone image data which indicates ~~the~~ a
>
> presence or absence of ink dots to print ~~a~~ said plurality of ~~said~~ patches
>
> [**Fig. 5** "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63,**
>
> **64**;

> From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by
>
> "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in
>
> turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone
>
> image data];

> wherein gradation values corresponding to said ink quantities are so
>
> defined that a gradation value which is an integral value existing in a
>
> predetermined range of ~~value~~ values and corresponds to a ~~higher~~ high-
>
> lightness range will be reduced in ~~the~~ an ink recording rate corresponding
>
> to ~~the~~ a unit variation in that gradation value as compared with gradation
>
> values corresponding to a ~~lower~~ low-lightness range

[For a printer with both light and dark marking particles, MAHY teaches a step

where a colorant tone value is separated into separate tone values for both light

and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31**

and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that

transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and

into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine

respectively an amount of light cyan marking particles and an amount of dark

cyan marking particles that are to be applied to a receiving substrate"; **col. 22,**

lines 2 – 8. With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a

larger reduction in ink recording rate at lower input tone values (i.e., in the higher-

lightness range) than at higher input tone values (i.e., in the lower-lightness

range). **Fig. 5** further illustrates that both light and dark tone values are further

calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are

complemented by the "screening LUT's" **66, 67, 68, 69]**;

and wherein in said halftone processing, <u>gradations are represented by</u>

<u>adjusting a count of dots recorded per unit area</u>

[MAHY teaches that "*the invention may be applied to ink-jet printing. The*

printing device is then an ink-jet printing device and the marking particles are

liquid ink drops. The invention is especially suitable for ink-jet printing, because

in ink-jet printing it is common to use a plurality of different types of inks of the

same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 –**

36.

It is well-known in the art that ink-jet printers can halftone image data by

modulating the number of dots placed in a unit area of the receiving medium.

This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,**

where applicant cites, "Rather, an ink-jet printer can change the number of dots

applied to a medium per unit area to represent gradation value"],

and one step-variation in gradation results in a large number of steps in dot

variation, thus subtle variation which is substantially equivalent to a

fractional portion is represented

[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From

this table, MAHY illustrates a mapping between a colorant value, c_K to a tone

value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a

corresponding, larger variation in tone value (t_K) than at higher colorant values

(c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone

value t_K varies from 0% to 12%; a difference of 12%. When c_K is in the range of

20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a

difference of 5%.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to place more dots on the receiving medium for a one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is important because printing devices can only render a limited number of different shades of a specific colour... This number is limited because of many involved and often interrelated factors, such as the image resolution and the screening technique that are used, *the number of bits that are used to represent a colour in different stages of the process*, the number of levels of the halftoning process, ...**"; col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution "fractional portion"]**,**

and ink quantities corresponding to reference values in said patch data are interpreted according to ~~the~~ a definition of the gradation values, while keeping the subtle variation which is substantially equivalent to the fractional portion, to generate said half tone image data

[From **Fig. 5,** MAHY teaches that the tone values t^*_{c1} and t^*_{c2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{c1} and t^{**}_{c2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data].

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate *correspondence definition data* so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 12, MAHY further teaches the correspondence definition data creating method according to Claim 11, wherein

> **said gradation values corresponding to ink quantities are defined by allocating *the* total number of gradations to part of the range of value of ink recording rate**
>
> [With respect to **Fig. 8**, MAHY teaches a case when "there are almost no colour differences between the patches of a wedge in a specific tone value interval, usually an interval from a specific tone value A% to 100%"; **col. 24, lines 27 – 30**. In this case, MAHY teaches that the tone values above A% can be ignored (or "clipped"). "The advantage of the clipping operation is that the average

spacing between the t-levels in the interval from 0% to A% may be smaller, which

results in more accurate colour representation"; **col. 24, lines 44 - 47].**

12. Claims 7, 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over

JACOBS [US Patent 5,481,655] in view of **MAHY [6,575,095 B1]** and **KAKUTANI**

[US Patent 6,439,682 B1].

As for claim 7, JACOBS teaches a print controller which refers to a color conversion

table **[Fig. 6** custom ink table **74]** which defines ~~the~~ a correspondence between ink

value data which specifies ~~the~~ ink quantities of inks in individual colors used in a printing

device **[Fig. 6** master ink table **70]** and ~~the~~ color component values of various colors

used in another image device **[Fig. 6** monitor model **22]**, and creates print data which

indicates output images on the printing device from image data which indicates display

images on the image device and causes a print operation to be performed, the

controller ~~comprises~~ comprising:

an image data acquiring unit ~~for acquiring~~ that acquires image data where

~~the~~ a color at each pixel in a matrix pattern is rendered with gradations with

respect to images on said another image device

[Fig. 1 "image in monitor color space" **10** acquires the image data which is

displayed on a monitor; "Image 10 is typically provided from the user in a first

coordinate system, such as any suitable RGB coordinate system"; **col. 4, lines**

41 - 43];

a color converting unit which extracts gradation values

["The custom ink table 74 comprises a plurality of output ink values

corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 – 21.** The

input to this table consists of image data gradation values for the "another image

device".]

where ~~the~~ an ink quantity and ~~the~~ a magnitude of gradation values are in

substantially linear correspondence with each other with respect to each ink color

and combines the gradation values to create first gradation value data,

subjects the first gradation value data to correction for resolution enhancement

with a higher rate of increase applied to a gradation value corresponding to a

~~higher~~ high-lightness range than to gradation values corresponding to a ~~lower~~

low-lightness range to obtain said ink value data,

subjects the ink value data to halftone processing, taking into account deviations

equivalent to fractional portions obtained when correction inverse to said

correction for resolution enhancement is carried out, and performs the print

operation~~.~~;

a color conversion table generating unit that generates a color conversion

table where said ink value data and the color component values of various

colors used in said another image device are in correspondence with each

other based on color measuring data [using a spectrophotometer **36** as shown

in **Fig. 2**] **obtained by subjecting the result of the print operation to color**

measuring

[**Fig. 6** custom table builder **72** produces a "custom ink table" **74** by bringing

colors indicated by combinations of input gradation values (i.e., the "master ink

table" **70** of the printer) and colors indicated by combinations of said color

component values (i.e., the monitor model **22**) into correspondence with each

other],

said first gradation value data being extracted beforehand so that colors in the

low-lightness range will be larger in number than colors in the high-lightness

range so as to compensate the resolution which is relatively degraded in the low-

lightness range by said correction for resolution enhancement by interpolation

accuracy,

and said color converting unit refers to the thus generated color

conversion table to color-convert said image data into corresponding ink

value data

["The custom ink table 74 comprises a plurality of output ink values

corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 - 21**];

a halftone processing unit for interpreting ink quantities indicated by the ink value

data from the color-converted ink value data and transforming the ink quantities

into pseudo half-tone data where gradations are represented by ~~the~~ a recording

density of ink droplets recorded on a printing medium, wherein said half tone

processing, gradations are represented by adjusting a count of dots recorded per

unit area, and one step-variation in gradation results in a large number of steps in

dot variation, thus subtle variation which is substantially equivalent to a fractional

portion is represented;

a print data creating unit which creates print data for driving and causing the

printing device to discharge ink droplets according to the recording density

specified by said pseudo half-tone data with respect to each pixel;

and a print data outputting unit ~~for outputting~~ that outputs the print data to the

printing device.

However, JACOBS does not teach

where ~~the~~ an ink quantity and ~~the~~ a magnitude of gradation values are in

substantially linear correspondence with each other with respect to each

ink color and combines the gradation values to create first gradation value

data,

subjects the first gradation value data to correction for resolution

enhancement with a higher rate of increase applied to a gradation value

corresponding to a ~~higher~~ high-lightness range than to gradation values

corresponding to a ~~lower~~ low-lightness range to obtain said ink value data,

subjects the ink value data to halftone processing, taking into account

deviations equivalent to fractional portions obtained when correction

inverse to said correction for resolution enhancement is carried out, and

performs the print operation~~,~~;

said first gradation value data being extracted beforehand so that colors in

the low-lightness range will be larger in number than colors in the high-

lightness range so as to compensate the resolution which is relatively

degraded in the low-lightness range by said correction for resolution

enhancement by interpolation accuracy,

a halftone processing unit for interpreting ink quantities indicated by the

ink value data from the color-converted ink value data and transforming the

ink quantities into pseudo half-tone data where gradations are represented

by ~~the~~ a recording density of ink droplets recorded on a printing medium,

wherein said half tone processing, gradations are represented by adjusting

a count of dots recorded per unit area, and one step-variation in gradation

results in a large number of steps in dot variation, thus subtle variation

which is substantially equivalent to a fractional portion is represented;

a print data creating unit which creates print data for driving and causing

the printing device to discharge ink droplets according to the recording

density specified by said pseudo half-tone data with respect to each pixel;

and a print data outputting unit ~~for outputting~~ that outputs the print data to

the printing device.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4**

and 5 illustrate the conversion of color data from one color space (e.g., L*a*b* on the

left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened")

CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone

data for cyan which consists of both light and dark marking particles).   In this

conversion process, MAHY illustrates a process for creating calibration tables

where ~~the~~ an ink quantity and ~~the~~ a magnitude of gradation values are in

substantially linear correspondence with each other with respect to each

ink color and combines the gradation values to create first gradation value

data

[**Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow,

and black, respectively; **TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for

black) and the relation between colorant value, c_K and tone value t_K; the

corresponding lookup table (LUT) attempts to linearize the response (i.e., the

"lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K

which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g.,

c_K) to tone values (e.g., t_K)],

subjects the first gradation value data to correction for resolution

enhancement with a higher rate of increase applied to a gradation value

corresponding to a ~~higher~~ high-lightness range than to gradation values

corresponding to a ~~lower~~ low-lightness range to obtain said ink value data

[For a printer with both light and dark marking particles, MAHY teaches a step

where a colorant tone value is separated into separate tone values for both light

and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31**

and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that

transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and

into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine

respectively an amount of light cyan marking particles and an amount of dark

cyan marking particles that are to be applied to a receiving substrate"; **col. 22,**

lines 2 – 8. With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a

larger reduction in ink recording rate at lower input tone values (i.e., in the higher-

lightness range) than at higher input tone values (i.e., in the lower-lightness

range). **Fig. 5** further illustrates that both light and dark tone values are further

calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are

complemented by the "screening LUT's" **66, 67, 68, 69],**

subjects the ink value data to halftone processing, taking into account

deviations equivalent to fractional portions obtained when correction

inverse to said correction for resolution enhancement is carried out, and

performs the print operation

[**Fig. 5** "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63,**

64;

From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by

"screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in

turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone

image data];

said first gradation value data being extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy

[**Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively; **TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**],**

a halftone processing unit for interpreting ink quantities indicated by the ink value data from the color-converted ink value data and transforming the ink quantities into pseudo half-tone data where gradations are represented by ~~the~~ a_recording density of ink droplets recorded on a printing medium [**Fig. 5** "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63, 64;**

From **Fig. 5,** MAHY teaches that the tone values t^*_{c1} and t^*_{c2} are interpreted by

"screening LUT's" **66, 67, 68, 69** to produce t^{**}_{c1} and t^{**}_{c2}, respectively which, in

turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone

image data]**,**

wherein said half tone processing, gradations are represented by adjusting

a count of dots recorded per unit area

[MAHY teaches that *"the invention may be applied to ink-jet printing.* The

printing device is then an ink-jet printing device and the marking particles are

liquid ink drops. The invention is especially suitable for ink-jet printing, because

in ink-jet printing it is common to use a plurality of different types of inks of the

same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 –**

36.

It is well-known in the art that ink-jet printers can halftone image data by

modulating the number of dots placed in a unit area of the receiving medium.

This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,**

where applicant cites, "Rather, an ink-jet printer can change the number of dots

applied to a medium per unit area to represent gradation value"]**,**

and one step-variation in gradation results in a large number of steps in dot

variation, thus subtle variation which is substantially equivalent to a

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[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From

this table, MAHY illustrates a mapping between a colorant value, c_K to a tone

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At lower colorant values (c_K), a one step variation in gradation results in a

corresponding, larger variation in tone value (t_K) than at higher colorant values

(c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone

value t_K varies from 0% to 12%; a difference of _12%_. When c_K is in the range of

20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a

difference of _5%_.

Therefore, it would have been obvious to one of ordinary skill in the art at the

time the invention was made to place more dots on the receiving medium for a

one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is

important because printing devices can only render a limited number of different

shades of a specific colour… This number is limited because of many involved

and often interrelated factors, such as the image resolution and the screening

technique that are used, *the number of bits that are used to represent a colour in different stages of the process*, the number of levels of the halftoning process, ...”; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution “fractional portion”**];**

KAKUTANI teaches a printing method and a printing apparatus. As shown in **Fig. 2**, the data from the “halftone module” **99** is sent to a “rasterizer” **100** which, in turn, sends data to the “printer” **22.** KAKUTANI teaches

> **a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half-tone data with respect to each pixel** [KAKUTANI cites, “The halftone module 99 creates dots in a dispersing manner and thereby implements the halftone processing, which enables the printer 22 to express the tone values. The *rasterizer 100 sorts the processed image data out in the sequence of data to be transferred to the printer* 22 and *outputs the sorted data as final print data FNL*”; **col. 14, lines 50 – 56.** The “rasterizer” corresponds to the “print data creating unit”**];**

> **and a print data outputting unit ~~for outputting~~ that outputs the print data to**
>
> **the printing device**
>
> **[As noted above, the "rasterizer" also outputs the print data to a printer].**

It would have been obvious to one of ordinary skill in the art at the time the invention

was made to combine the teachings of KAKUTANI and JACOBS with those of MAHY in

order to implement a print controller which utilized a color conversion table so that

colors output on one device would match those of a given printing device. JACOBS

teaches the concept of matching colors between output devices while MAHY teaches

the concepts of linearizing color output response, color separation and halftoning when

performing a print operation and KAKUTANI teaches the concept of preparing the

halftoned print data in a format usable by the printer.

As for claim 18, JACOBS teaches a print controller which refers to a correspondence

definition data [i.e., a color conversion table; **Fig. 6** custom ink table **74**] which defines

~~the~~ a correspondence between ink value data which specifies ~~the~~ ink quantities of inks

in individual colors used in a printing device **[Fig. 6** master ink table **70]** and ~~the~~ color

component values of various colors used in another image device **[Fig. 6** monitor model

22], and creates print data which indicates output images on the printing device from

image data which indicates display images on the image device and causes a print

operation to be performed, the controller comprising:

an image data acquiring unit ~~for acquiring~~ **that acquires image data where the color at each pixel in a matrix pattern is rendered with gradations with respect to images on said another image device**

[**Fig. 1** "image in monitor color space" **10** acquires the image data which is displayed on a monitor; "Image 10 is typically provided from the user in a first coordinate system, such as any suitable RGB coordinate system"; **col. 4, lines 41 - 43**];

a color converting unit which performs a print operation with a plurality of pieces of ink value data which specify said ink quantities of inks in individual colors

["The custom ink table 74 comprises a plurality of output ink values corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 – 21.** The input to this table consists of image data gradation values for the "another image device".],

obtained by correcting first gradation value data where ~~the~~ *an ink quantity and* ~~the~~ *a magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a* ~~higher~~ *high-lightness range than to gradation values corresponding to a* ~~lower~~ *low-lightness range;*

refers to correspondence definition data where said ink value data and ~~the~~

color component values of various colors used in said another image

device are in correspondence with each other

["The custom ink table 74 comprises a plurality of output ink values

corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 – 21.** The

input to this table consists of image data gradation values for the "another image

device".],

based on color measuring data obtained by subjecting ~~the~~ a result of the

print operation to color measuring and color-converts said image data into

corresponding ink value data;

["a spectrophotometer 36 … is utilized to measure the color value, in the selected

colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 -**

51];

a halftone processing unit which interprets ink quantities indicated by the ink

value data from the color-converted ink value data and transforms the ink

quantities into pseudo half tone data where gradations are represented by ~~the~~ a

recording density of ink droplets recorded on a printing medium, wherein in said

half tone processing, gradations are represented by adjusting a count of dots

recorded per unit area, and one step-variation in gradation results in a large

number of steps in dot variation, thus subtle variation which is substantially

equivalent to a fractional portion is represented;

a print data creating unit which creates print data for driving and causing the

printing device to discharge ink droplets according to the recording density

specified by said pseudo half tone data;

and a print data outputting unit which outputs the print data to the printing device.

However, JACOBS does not teach

obtained by correcting first gradation value data where ~~the~~ an ink quantity

and ~~the~~ a magnitude of gradation values are in substantially linear

correspondence with each other with a higher rate of increase applied to a

gradation value corresponding to a ~~higher~~ high-lightness range than to

gradation values corresponding to a ~~lower~~ low-lightness range;

a halftone processing unit which interprets ink quantities indicated by the

ink value data from the color-converted ink value data and transforms the

ink quantities into pseudo half tone data where gradations are represented

by ~~the~~ a recording density of ink droplets recorded on a printing medium,

wherein in said half tone processing, gradations are represented by

adjusting a count of dots recorded per unit area, and one step-variation in

gradation results in a large number of steps in dot variation, thus subtle

variation which is substantially equivalent to a fractional portion is

represented;

a print data creating unit which creates print data for driving and causing

the printing device to discharge ink droplets according to the recording

density specified by said pseudo half tone data;

and a print data outputting unit which outputs the print data to the printing

device.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4**

and 5 illustrate the conversion of color data from one color space (e.g., L*a*b* on the

left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened")

CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone

data for cyan which consists of both light and dark marking particles).   In this

conversion process, MAHY illustrates a process for creating calibration tables

obtained by correcting first gradation value data where ~~the~~ an ink quantity

and ~~the~~ a magnitude of gradation values are in substantially linear

correspondence with each other with a higher rate of increase applied to a

gradation value corresponding to a ~~higher~~ high-lightness range than to

gradation values corresponding to a ~~lower~~ low-lightness range

[For a printer with both light and dark marking particles, MAHY teaches a step

where a colorant tone value is separated into separate tone values for both light

and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31**

and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that

transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and

into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine

respectively an amount of light cyan marking particles and an amount of dark

cyan marking particles that are to be applied to a receiving substrate"; **col. 22,**

lines 2 – 8. With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a

larger reduction in ink recording rate at lower input tone values (i.e., in the higher-

lightness range) than at higher input tone values (i.e., in the lower-lightness

range). **Fig. 5** further illustrates that both light and dark tone values are further

calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are

complemented by the "screening LUT's" **66, 67, 68, 69**];

a halftone processing unit which interprets ink quantities indicated by the

ink value data from the color-converted ink value data and transforms the

ink quantities into pseudo half tone data where gradations are represented

by ~~the~~ a recording density of ink droplets recorded on a printing medium

[**Fig. 5** "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63,**

64;

From **Fig. 5,** MAHY teaches that the tone values t^*_{c1} and t^*_{c2} are interpreted by

"screening LUT's" **66, 67, 68, 69** to produce t^{**}_{c1} and t^{**}_{c2}, respectively which, in

turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone

image data]**,**

wherein in said half tone processing, gradations are represented by

adjusting a count of dots recorded per unit area

[MAHY teaches that "*the invention may be applied to ink-jet printing.* The

printing device is then an ink-jet printing device and the marking particles are

liquid ink drops. The invention is especially suitable for ink-jet printing, because

in ink-jet printing it is common to use a plurality of different types of inks of the

same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 –**

36.

It is well-known in the art that ink-jet printers can halftone image data by

modulating the number of dots placed in a unit area of the receiving medium.

This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,**

where applicant cites, "Rather, an ink-jet printer can change the number of dots

applied to a medium per unit area to represent gradation value"]**,**

and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented

[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From this table, MAHY illustrates a mapping between a colorant value, c_K to a tone value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a corresponding, larger variation in tone value (t_K) than at higher colorant values (c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone value t_K varies from 0% to 12%; a difference of 12%. When c_K is in the range of 20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a difference of 5%.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to place more dots on the receiving medium for a one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is important because printing devices can only render a limited number of different shades of a specific colour... This number is limited because of many involved

and often interrelated factors, such as the image resolution and the screening

technique that are used, *the number of bits that are used to represent a colour in*

different stages of the process, the number of levels of the halftoning process,

...”; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to*

represent color allows for finer variations to be expressed which correspond to a

computationally higher resolution “fractional portion”**];**

KAKUTANI teaches a printing method and a printing apparatus. As shown in **Fig. 2**, the

data from the “halftone module” **99** is sent to a “rasterizer” **100** which, in turn, sends

data to the “printer” **22.** KAKUTANI teaches

> **a print data creating unit which creates print data for driving and causing**
>
> **the printing device to discharge ink droplets according to the recording**
>
> **density specified by said pseudo half tone data**
>
> **[**KAKUTANI cites, “The halftone module 99 creates dots in a dispersing manner
>
> and thereby implements the halftone processing, which enables the printer 22 to
>
> express the tone values. The *rasterizer 100 sorts the processed image data out*
>
> *in the sequence of data to be transferred to the printer* 22 and *outputs the sorted*
>
> *data as final print data FNL*”; **col. 14, lines 50 – 56.** The “rasterizer” corresponds
>
> to the “print data creating unit”**];**

and a print data outputting unit which outputs the print data to the printing

device

[As noted above, the "rasterizer" also outputs the print data to a printer].

It would have been obvious to one of ordinary skill in the art at the time the invention

was made to combine the teachings of KAKUTANI and JACOBS with those of MAHY in

order to implement a print controller which utilized a color conversion table so that

colors output on one device would match those of a given printing device. JACOBS

teaches the concept of matching colors between output devices while MAHY teaches

the concepts of linearizing color output response, color separation and halftoning when

performing a print operation and KAKUTANI teaches the concept of preparing the

halftoned print data in a format usable by the printer.

Response to Arguments

1.   Applicant's arguments filed 1/10/2008 have been fully considered but they are

not persuasive.

With respect to applicant's argument that MAHY does not teach

      a first limitation

      wherein in said half tone processing, gradations are represented by adjusting a

      count of dots recorded per unit area

and a second limitation wherein

one step-variation in gradation results in a large number of steps in dot variation,

thus subtle variation which is substantially equivalent to a fractional portion is

represented

has been considered.

In reply:

Regarding the first limitation, MAHY teaches that "*the invention may be applied*

to ink-jet printing. The printing device is then an ink-jet printing device and the

marking particles are liquid ink drops. The invention is especially suitable for ink-

jet printing, because in ink-jet printing it is common to use a plurality of different

types of inks of the same colorant hue, such as light cyan ink and dark cyan ink";

col. 25, lines 30 – 36.

It is well-known in the art that ink-jet printers can halftone image data by

modulating the number of dots placed in a unit area of the receiving medium.

This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,**

where applicant cites, "Rather, an ink-jet printer can change the number of dots

applied to a medium per unit area to represent gradation value".

Regarding the second limitation, MAHY illustrates a tone calibration table (see

TABLE 1 in **cols. 16, 17**). From this table, MAHY illustrates a mapping between

a colorant value, c_K to a tone value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a

corresponding, larger variation in tone value (t_K) than at higher colorant values

(c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone

value t_K varies from 0% to 12%; a difference of 12%. When c_K is in the range of

20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a

difference of 5%.

Therefore, it would have been obvious to one of ordinary skill in the art at the

time the invention was made to place more dots on the receiving medium for a

one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is

important because printing devices can only render a limited number of different

shades of a specific colour... This number is limited because of many involved

and often interrelated factors, such as the image resolution and the screening

technique that are used, *the number of bits that are used to represent a colour in*

different stages of the process, the number of levels of the halftoning process,

..."; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution "fractional portion".

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

- U.S. Patent 5,818,604 A [DELABASTITA et al.]

- U.S. Patent 2002/0024687 [ALLEN et al.]

- U.S. Patent 2003/0002058 A1 [COUWENHOVEN et al.]

2.   **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later

than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Peter L. Cheng whose telephone number is 571-270-

3007. The examiner can normally be reached on MONDAY - FRIDAY, 8:30 AM - 6:00

PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, King Y. Poon can be reached on 571-272-7440. The fax phone number for

the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the

Patent Application Information Retrieval (PAIR) system. Status information for

published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see http://pair-direct.uspto.gov. Should

you have questions on access to the Private PAIR system, contact the Electronic

Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a

USPTO Customer Service Representative or access to the automated information

system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/King Y. Poon/
Supervisory Patent Examiner, Art Unit 2625

plc
April 10, 2008